Master's thesis project

Parameter identification in models of cardiac electrophysiology

Computer simulations have proved to be very useful as tools for research on biological systems and may also come to play important roles in medical diagnosis. The simulations are often based on mathematical models comprising nonlinear differential equations, which given suitable input data in the form of detailed measurements of geometry and material parameters are able to represent with good accuracy the behavior of the real-world system under study. Advances in medical imaging technologies have made acquisition of detailed geometrical data relatively straightforward, but in many situations, material parameters are unfortunately not available for direct measurements and one therefore has to resort to indirect methods; i.e., parameter identification or estimation.

This thesis project concerns parameter identification in systems of non-linear reaction-diffusion equations based on the so-called FitzHugh-Nagumo model. These models have been devised to capture important qualitative aspects of cardiac electrophysiology while at the same time being relatively simple. In this project you will implement one of these models and try to identify parameters in it using limited data, such as measurements of the "electric potential" on the boundary of the modelled system. In general, this type of problems lack unique solutions and methods for alleviating this issue should therefore be tested.

The project is suitable for students at the M- or Y-programmes, or with similar background. Experience of the following is desirable:

- Applied numerical optimization. This could mean for instance optimal control or structural optimization (TMMS20).
- Numerical methods for solving PDEs, such as finite elements or finite differences.
- Programming in Matlab and/or C/C++

If this seems interesting, please contact Carl-Johan Thore at the Division of Mechanics.

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